

# Batteries in Hybrid Systems

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## PV/Wind/Diesel System: Rotwandhaus in the German Alps

- Hikers Inn with more than 100 accommodations for overnight stays and up to 1,000 guests for catering per day (depending on weather)
- Annual energy consumption 11,000 kWh: photovoltaic (PV) and wind systems provide 65% of power.
- 5.5-kWp PVsystem, 20-kW wind generator, 100-kWh battery storage, and 30-kVA diesel generator
- Field test on two 300-Ah battery strings with nominal voltage of 162 V with gel batteries



PV/wind/diesel system in the German Alps (Rotwandhaus)



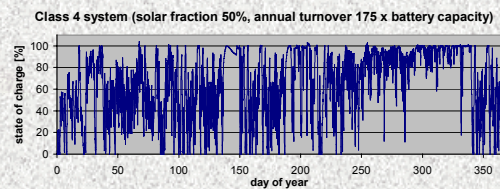
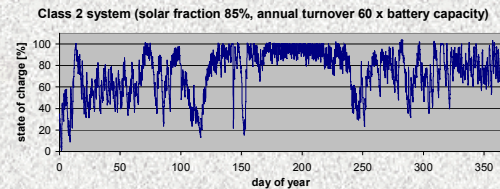
Test of battery-charging strategies for valve-regulated batteries in a PV system on four independent battery strings (system Talhof)

## Testing and Evaluation of Charging Strategies

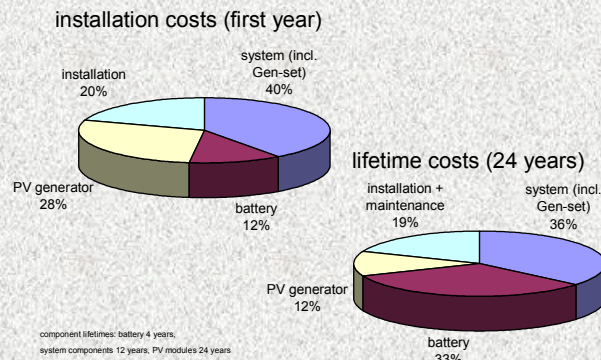
- Charging strategies for batteries in hybrid systems are different from those in classical battery applications.
- Valve-regulated batteries are increasingly penetrating this market.
- Until recently, adequate charging strategies to provide maximum lifetime for valve-regulated batteries in PV systems were unknown. More R&D is needed.

## Classification of Battery Operating Conditions

- Battery operating conditions in hybrid systems vary considerably, depending on solar fraction and system sizing.
- Different operation profiles require adapting charging strategies and battery technologies.
- Ideal adaptation of system design, battery technology, and operating strategy reduces costs.
- Careful system sizing and lifetime-cost evaluation are necessary.



State-of-charge profiles for different classes of operating conditions



Comparison of battery cost share on initial investment costs and on overall lifetime costs (PV/diesel/battery system, approx. 2,000 kWh/year)

## Batteries are a Major Cost Factor in Hybrid Systems

- The share of initial investment costs for batteries is relatively small compared to the overall investment costs.
- Because of the short lifetimes and the maintenance effort, costs for the battery greatly exceed those for the PV generator.
- Batteries, maintenance, and repair can account for more than 50% of the overall lifetime costs.